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New Indicators Reveal Weak Spots in US Science

The National Science Board has issued a cautiously report which suggests that, by several indicators, American leadership in world science and technology is deteriorating.

The report, entitled *Science Indicators 1972*, presents "the first results from a newly initiated effort to develop indicators of the state of the science enterprise in the United States." It surveys a mass of data, ranging from employment statistics to equipment purchases to patent awards, and concludes that the American performance is improving in some areas, holding even in others, and weakening in still others.

But what it all means is left for the individual reader to divine. The board itself makes no overall judgment about the health of American science, largely because the indicators it used were too incomplete to measure the entire scientific enterprise and because even those limited indicators were difficult to interpret.

As Herbert E. Carter, the board's chairman, expressed it in a cover letter:

"The ultimate goal of this effort is a set of indices which would reveal the strengths and weaknesses of U.S. science and technology, in terms of the capacity and performance of the enterprise in contributing to national objectives. If such indicators can be developed over the coming years, they should assist in improving the allocation and management of resources for science and technology, and in guiding the Nation's research and development along paths most rewarding for our society.

"Because of present limitations in data and methodology, the indicators in this Report deal principally with resources — funds, manpower, and equipment — for research and development and the areas to which the resources are directed. The report presents relatively few measures of the outputs produced from these resources — the scientific advances and technological achievements, and their contributions to the progress and welfare of the Nation. The present paucity of such indices limits the conclusions which can be drawn concerning the quality and effectiveness of our scientific and technological effort."

Despite the caveats, the report from the 25-member board, the policy-making body for the National Science Foundation, appears to be the most authoritative government appraisal of American science yet issued. It was submitted to the White House in August, then transmitted by the White House to Congress on Sept. 5, in accord with legislation that requires the board to prepare an annual report on science. (The report can be obtained from the U.S. Government Printing Office, Washington, D.C. 20402. Price: $3.35. Stock No. 3800-00146.)

Although the report draws no overall conclusion and makes no recommendations, it documents trends which some individual members of the board view with concern. The chief findings include:

International Comparisons

The report makes no effort to compare national scientific performances by some absolute standard "because of the paucity and limited quality of available information." It notes that the costs of

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In Brief

Surrounded by public relations smoothies, renowned Bell Labs radiates an image of pure competence and high productivity, but insiders say there's more than a bit of trouble between the lab and its parent organization, the Bell System. Ever since the video phone disaster, which the lab pushed to a cost of at least $100 million before marketing studies showed it to be a clever gadget but one without customer appeal, Bell has been pressing hard for quicker payoff and less of the academic flavor for which the lab is noted. Old timers at the lab are growling that scientific excellence is threatened.

The National Academy of Sciences' report on the health and environmental effects of the massive US herbicide-spraying campaign in Vietnam, sure to be controversial when finally released, has been delayed. The Academy was supposed to deliver its final report to DOD by the end of August, and DOD was required to forward it to Congress by the end of September. But instead of a report, the Academy submitted a request for a three-month extension to examine what an Academy spokesman called "new data that came in late." The Academy won't reveal what the allegedly new information is because "there are some ticklish aspects that we don't want to talk about."

Up the corporate ladder: Berkeley Nobel physicist Charles H. Townes, founding chairman of the science advisory committee that General Motors established in 1971, has been appointed to GM's board of directors.

Our favorite committee name: The Committee for Invisible Transactions, part of the Organization for Economic Cooperation and Development.

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research, the productivity of scientists and engineers, and the definitions of R&D and scientific personnel differ from one country to the next, with the result that it is not yet possible to equate the figures published by various countries. Comparisons with the USSR are particularly difficult. Thus, although it is generally accepted that the US is the world leader in science and technology, the report sheds little light on the dimensions of that lead. Instead, it discusses general trends and relative changes. Several indicators suggest that the American lead, whatever its dimensions, is eroding.

To begin with, the American level of effort, in terms of expenditures and manpower devoted to R&D, appears to be slackening. The proportion of the gross national product (GNP) spent for R&D in the United States dropped from 3.04 per cent in 1964 to 2.60 per cent in 1971. (Expenditures for R&D increased but GNP increased even faster.) France and Britain also experienced declines while the USSR, Japan and West Germany showed increases. The US showed the largest reductions, the USSR and Japan the largest increases.

Similarly, the number of scientists and engineers engaged in R&D per 10,000 population declined in the United States after 1969 but continued to increase in the USSR, Japan, West Germany, and France, with the result that by 1971 the number per 10,000 population for the USSR was 37 as compared with 25 for the United States and Japan, 15 for West Germany, and 12 for France.

These declines in the resources applied to R&D were accompanied by a deterioration in the "results" from R&D. The most disturbing evidence was a decline in the "patent balance" between the US and other countries. US nationals continue to win many more patent awards from foreign nations than foreign nationals win from the US, but the balance dropped by 40 per cent between 1966 and 1970, partly because US inventors were decreasingly successful at winning patents in Western Europe, and partly because Japanese inventors won an increasing number of patents in the US. The patent statistics are considered a measure of the strength of industrial and applied research. The report gloomily interprets the data to mean that "the rate of growth of patentable ideas of international merit has been expanding at a greater rate in other countries than in the United States."

The statistics were somewhat more buoyant with respect to the results from basic research. In seven of eight scientific areas studied, the US produced a larger share of the world's scientific and technical literature than any other country; its share remained essentially unchanged between 1965 and 1971. (The Russians led in one area — chemistry and metallurgy.) What's more, the articles produced by US scientists were of higher "quality" or "significance" than those produced by other scientists, as was demonstrated by the fact that US-produced literature was cited more frequently in all scientific areas studied, except for systematic biology and mathematics where Britain stood first.

But the US lead may deteriorate. Robert W. Brainard, staff director for the report and head of NSF's Science Indicators Unit, told SGR there is already evidence — not included in this report but apt to be reflected in the next — that US production of scientific articles has declined "in a few selected fields."

The report contains a final group of indicators that measure national performance in areas that depend upon science and technology but are affected by many other factors as well. The difficulty in separating out the distinct contribution of R&D makes it difficult to interpret the significance of the data.

The US had an increasingly favorable position in the sale of "technical know-how" — patents, techniques, formulas, franchises, and manufacturing rights — during 1960-1971. Japan was the major purchaser of US "know-how," surpassing all of Western Europe after 1967. The report makes no comment as to whether this trend is good or bad. Some observers interpret the data as evidence of American superiority in generating "know-how;" others see it as evidence of American naivete in selling knowledge cheaply to foreign competitors.

The US also had an increasingly favorable balance of trade in technology-intensive products throughout 1960-1971, but "various indicators suggest that the position may deteriorate in the near future. Not only did the overall trade balance for high technology industries level off between 1970-71, but the two industries most responsible for the favorable balance in previous years (nonelectrical machinery and chemicals) had their first decline in net exports in 1971."

Basic Research

Some of the most disturbing indicators in the report, in the opinion of many National Science

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Panel Urges Reallocation of Basic Research Funds

Federal funds for basic research should be reallocated so that a relatively smaller percentage is spent on the life, physical and environmental sciences while a higher percentage is spent on social sciences, engineering, psychology and mathematics.

That's the opinion of a panel of 33 leading scientists polled by the National Science Board. This controversial finding is revealed in a chart buried deep in the board's annual report.

The panelists reached their conclusion after deciding that allocation of basic research funds should depend primarily upon opportunities for the advancement of knowledge and the potential for applying this knowledge to practical ends.

Muskie Says OMB Undercuts EPA Health Research

The Nixon Administration is reducing the Environmental Protection Agency's responsibility for research into the health effects of air pollution and is turning to the Department of Health, Education and Welfare to provide more guidance on the health basis for air pollution control.

This is suggested in internal Administration documents made public on September 6 by Sen. Edmund S. Muskie (D-Maine), chairman of the Senate subcommittee on air and water pollution and chief author of the Clean Air Act Amendments of 1970, which called for a stringent crackdown on pollution to protect the public health.

The chief motivation for the switch is apparently Administration concern that EPA has become too vigorous an "advocate" in pushing for pollution restrictions that will have a substantial economic impact.

One document released by Muskie was a July 27 memo, written by Carl M. Shy, acting director of EPA's health research program, and entitled "Substantial Decline in Agency Support for the Air Health Programs." The memo noted that a Presidential Initiative called for adding $5 million per year for five years to the air health program, starting in fiscal 1973, "with the understanding that these monies would fund new programs and would not be used in place of regular agency support for the health program." Yet in both 1973 and 1974 the budget was reduced substantially below the 1972 base before adding on the $5 million. In fiscal 1974 the approved budget was almost $1.6 million below the 1972 base, and inflation has further eroded the buying power of that money. These funding reductions "have been matched by even greater manpower reductions" — the air health program had only 161 approved positions in 1974, down from 208 in 1972.

"These figures are given at this time to document the lack of commitment to our Agency to the intent of the Presidential Initiatives program and to the health program in general," Shy wrote. "These substantial budgetary reductions have occurred in the face of mounting criticism of the health basis for our air quality standards, and in view of appeals from both within and outside the Agency for more scientific and credible air quality standards. The declining level of support suggests that the Agency is not responsive to these criticisms."

Another set of documents released by Muskie reveals that the Office of Management and Budget has asked HEW to "take the lead" in a cooperative study with EPA aimed at documenting current understanding of the health effects of sulfur oxides in ambient air. That can be interpreted as a slap at EPA, which has been studying the sulfur oxides issue for some time now and has repeatedly concluded that strict control is justified. One academic expert quoted in the internal documents concluded that "EPA was being critically reviewed by the OMB effort." And an OMB official was quoted as being "concerned about the economic impact" of the Clean Air Act of 1970.

Muskie, whose subcommittee is holding hearings on that legislation this month, said he was "appalled" at evidence that EPA is cutting back its health research — and also its monitoring efforts — at a time when crucial decisions are about to be made on the necessity for stringent pollution standards. Muskie interpreted the decision to give HEW prime responsibility for health research on sulfur oxides as evidence that OMB "does not like the results of the studies which EPA has provided . . . I can only conclude that this OMB mandated study is designed to justify a weaker sulfur oxides regulatory policy."

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Board members, are those which document a downturn in the resources devoted to basic research. Expenditures for such research, expressed in constant dollars, peaked in 1968, then declined almost continuously, with the result that 1972 expenditures were 6 per cent lower than the peak year. The largest decline occurred in industry (14 per cent), the least in colleges and universities (3 per cent).

The declines did not hit all fields evenly. Total expenditures (federal and non-federal) for basic research in colleges and universities, expressed in constant dollars, increased for the biological sciences, clinical medicine, social sciences, and psychology and decreased for astronomy, physics, chemistry and engineering. Though the report did not say so, some board members were particularly concerned over a 25 per cent drop in federal support for physics between 1968 and 1972.

There was also concern, again not made explicit in the report, over the fact that research funds per scientist and engineer in Ph.D.-granting institutions declined 15 percent between 1968 and 1972 in constant dollars. The drop was caused partly by reduced federal expenditures, and partly by continued growth of faculty. The funds per investigator decreased in all fields except the social sciences, with the largest declines occurring in physics (32 per cent), clinical medicine (21 per cent), and engineering (17 per cent).

Federal support for young investigators — those holding a Ph.D. less than seven years — in universities and colleges declined to a greater extent than support for senior investigators. The report warns that "the progress and quality of future research and innovation depend increasingly on individuals from this group."

An opinion survey of 12 scientists chosen for their expertise in the interaction of science, technology and society judged that there was an "increasingly inadequate" level of support for high risk-high pay-

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New Patent Rules Affect Contractors, Grantees

The Nixon Administration's efforts to spur economic growth by liberalizing the allocation of patent rights in inventions made under government contracts and grants moved forward in recent weeks with the issuance of two proposed regulations on patent policy.

On September 4, the General Services Administration published in the *Federal Register* a revision of federal procurement regulations pertaining to "inventions made in the course of or under a contract or subcontract . . . where a purpose is the conduct of experimental, developmental, or research work." The regulations would govern all the civilian agencies of the executive branch. They would be mandatory for contracts and could also be applied to grants at an agency's discretion.

The chief thrust of the new regulations, which are to become effective next March 4, after interested parties have had a chance to comment, is to provide procedures for implementing President Nixon's 1971 statement on government patent policy. That statement made it easier for private parties to obtain patent rights in inventions resulting from federally-sponsored R&D on the theory that such liberalization would encourage new discoveries and speed the application of those discoveries to commercial use.

The proposed regulations contain six model clauses to be used in various circumstances for government contracts with industrial concerns and with non-profit organizations such as universities. The clauses that apply to educational institutions are simplified from those contained in previous drafts of the regulations circulated for comment.

The chief opposition to the new regulations has come from the Justice Department, which is circulating a memorandum that attacks the regulations on constitutional grounds. "It's mean and dirty," one government patent official complained of the memo.

Meanwhile, on August 31, the Department of Transportation published in the *Federal Register* its own proposed regulations governing patent rights to inventions made under DOT contracts and grants. A key provision of the regulations defines "special situations" in which DOT will agree in advance to award domestic rights to inventions that may arise under a research project. One of those special situations is an agreement with "an educational institution having a promulgated policy and an effective program for acquiring rights to inventions and for acting by itself or through others to bring the results of such inventions to practical application." Thus DOT joins HEW, NSF, DOD, and NASA in allowing qualified institutions a first option to administer inventions generated with government support (see SGR, Vol. III, No. 10).

NIE Plans Fund Boost For Research Grants

The National Institute of Education (NIE) will allocate 10 to 15 per cent of its fiscal 1974 budget to a research grants program under a policy adopted recently by the National Council on Educational Research, the top policy-making body for the fledgling agency.

Based on the Nixon Administration's fiscal 1974 budget request of $162 million for NIE, that would support a grants program of $16 million to $24 million. However, the specific size of the program will depend upon the final Congressional appropriation for NIE and the quality and relevance of the grant proposals submitted to the agency. The amount available is almost certain to be substantially higher than the $11 million that was allocated in fiscal 1973, the agency's first year of operation.

A resolution adopted by the National Council on August 6 states that "individual scholars, as well as research institutions, will be invited to propose research projects which address the fullest range of educational problems relevant to American education. The Institute will identify concerns of priority interest and make special efforts to seek and support research which may yield significant results in those areas. One area of special emphasis will be the education of persons from low-income families and minority communities in the United States . . . In addition to supporting research projects, the Institute will also work to develop a general framework which may guide and coordinate research and facilitate the dissemination of significant research findings to educators who may utilize them."

Detailed guidelines for the grants program will be issued later this month. Researchers will be asked to submit prospectuses by November and formal proposals by January, with grant awards to be made late in the spring.

MIT Still Tops Federal Funds Despite White House Anger

Nixon's henchmen may have been planning fiscal vengeance against Democrat-laden MIT, as was revealed in confidential memos recently brought to light by *Science*, but the latest tally for academic recipients of federal support shows MIT still at the top of the top 100.

The figures, compiled by NSF, cover fiscal 1972, and list MIT at $112.4 million, a healthy distance ahead of No. 2, the University of Washington, which received $73.2 million. Next came the University of Michigan, $66.8 million; Harvard, $65 million; University of Minnesota, $64.2 million, UCLA, $63.8 million, and University of Wisconsin-Madison, $62.5 million.

Though the Nixon crowd has amply demonstrated a fearsome capacity for petty spitefulness, the fact is that MIT and the federal government are fairly evenly matched in their need for each other, so much so, in fact, that the cutback plans never progressed beyond the memo stage.

NAS: Look Who's Advising on Development

The "stacking" of study committees to reflect a particular point of view is an old Washington pastime, and few institutions are as adept at it as the National Academy of Sciences (NAS). Recently, however, the Academy stacked a major study group in so blatant and potentially embarrassing a fashion that it felt compelled to include a bizarre explanation in the group's published report. It happened as follows:

Two years ago, the Agency for International Development asked the Academy "to examine the past and potential role of US firms in strengthening the research, development, and engineering capabilities in developing countries. . ."

The task was assigned to the Academy's Office of the Foreign Secretary, which, in collaboration with NAS's sister organization, the National Academy of Engineering, proceeded to put together an ad hoc panel. The chairmanship went to Charles S. Dennison, former vice president of International Minerals and Chemicals Corp.: also appointed were nine other top executives from US-based multinational firms, plus five American academics, and some 40 American consultants.

According to Hugh H. Miller, executive secretary of the NAS Foreign Office, the industrial emphasis and all-American makeup of the panel drew some protests from persons interested in the study. "Some thought we should bring in at least a few people from the less-developed countries to get their point of view," Miller told SGR, "But we didn't want to have encounter sessions. What we wanted to get was the attitudes of the multinationals."

After laboring for two years, the panel recently produced its report, *US International Firms and R, D & E in Developing Countries* (73 pages, no charge, Office of the Foreign Secretary, NAS, 2101 Constitution Ave. NW., Washington, D.C. 20418.) It is a melange of vapid observations and recommendations, reflective of the makeup of the panel, and including such gems as "less-developed countries should understand that multi-national corporation managers have a basic obligation to the corporation's stockholders to maximize long-term profits while exhibiting *reasonable* (italics supplied) social responsibility."

The fact that the study had not drawn upon any persons from the developing countries continued to be a sore point, however. Recognizing this, the panel included a statement to show that its corporate big cats and accompanying academics really contorted their minds to view the world from the perspective of the developing nations.

"The panel approached its task fully aware," the report states, "that the questions before it could not be viewed apart from the increasingly tense relations between the international investor community and the less-developed countries.. Because these tensions impinge so forcefully on corporate attitudes and plans, both the panel and the consultants gave them careful consideration. . . .

"Because the panel was composed entirely of North Americans, it could be accused of a one-sided view of strongly contended issues. The panel, however, had the benefit of detailed exposition, and frequent reiteration by the chair, of perspectives and attitudes prevalent in less-developed countries. Academic members, participants in the consultations, and especially the recent, highly articulate writings of opinion leaders in the less-developed countries — all presented the views of the other side. . . .

"In its efforts to respond to the demands and aspirations of developing countries, the panel had to be guided by what collective international experience has shown to be achievable and mutually beneficial to host country and investor companies alike. Its insistence on 'workability' — a characteristic of successful industry performance — helped ensure realism in assessing the limits of private sector action and, within these limits, the potentials for present and future action."

Well, that's an interesting approach to the study of "strongly contended issues." Maybe it should be employed the next time the Academy goes through one of its periodic numbers on how much money the federal government should put up for this or that scientific discipline. Membership of the ad hoc panel could be drawn from the Office of Management and Budget and various humanities departments; and for purposes of balance, the chair would have the task of presenting the "perspective and attitudes" of the scientific community.—DSG

In Print

Recent publications of more than routine interest:

Salaries of Scientists, Engineers and Technicians, A Summary of Salary Surveys, lists starting and senior salaries in industry, government, and academic institutions, with breakdowns by field, degree, sex, age, etc. (102 pages, $7.50 Scientific Manpower Commission, 1776 Massachusetts Ave., NW., Washington, D.C. 20036.)

Annual Report of the National Advisory Committee on Oceans and Atmosphere, resounds with distress over the Administration's budgetary cuts and alleged indifference in oceanic and atmospheric matters; supports Nixon's proposal to create a Department of Natural Resources (since rechristened Energy and Natural Resources), but the Committee says the Nixon plan reflects "an inadequate assessment of both the opportunities and problems of developing marine resources." (46 pages, 55 cents, US Government Printing Office, Washington, D.C. 20402.)

Panel Calls Nuclear Heart an Unjustified Risk

An advisory panel to the National Heart and Lung Institute has concluded that it would be "ethically unjustifiable" to implant nuclear-powered artificial hearts in human beings when battery powered alternatives could be used with less radiation hazard to people who come into contact with the recipient.

The conclusion is bound to be controversial, for it calls into question the safety of the technology that currently dominates the government's efforts to achieve an effective artificial heart. At present, only a prototype of a totally implantable artificial heart exists. Clinical trials are estimated to be a decade or more away.

In an effort to anticipate non-scientific problems that might arise from the new devices, the Heart Institute in 1972 appointed an Artificial Heart Assessment Panel and charged it with "detailing the economic, ethical, legal, medical, psychiatric and social implications of clinical application of a totally implantable artificial heart." The panel was chaired by Harold P. Green, professor of law at George Washington University, a frequent critic of nuclear hazards. It included three physicians, two economists, two lawyers, one sociologist, a priest-ethicist, and a political scientist.

The panel's final report — *The Totally Implantable Artificial Heart*, June 1973 — recommends that "the nuclear-powered artificial heart not be implanted in human beings until such time as it is established scientifically that there will be no significant risk of injury involuntarily imposed on other persons." The report opposes even implanting the nuclear device in a limited number of individuals on an experimental basis because of "our doubt that, if the experiments prove successful, it will be possible to hold the line against more widespread use of the nuclear system."

There are currently three alternative power sources under investigation. The panel reluctantly concluded that "the most attractive of these" — the biological fuel cell, which would use energy derived from muscles and other materials within the body — is too distant a prospect to provide a realistic alternative. That leaves the electric battery system and the nuclear system as the only candidates.

The nuclear system has been emphasized by the Heart Institute and by a smaller competing program run by the AEC, largely because of its technical and practical advantages. An implanted fuel capsule containing plutonium-238 would provide a reliable source of energy for ten years, whereas a battery system would have to be recharged regularly and replaced surgically at periodic intervals.

But the panel found "conspicuous disadvantages" to the nuclear system. It suggested that catastrophic accidents or criminal acts might occur. Among other things, it suggested the possibility that a nuclear chain reaction might be set off if a number of recipients gathered close together, and that recipients might be murdered by criminal elements who sought their plutonium to fabricate bombs. The panel acknowledged that it was "not technically competent to evaluate these problems;" it was assured by the ever-optimistic AEC that "the probability of such events ranges from exceedingly remote to impossible." The panel accepted these assurances with "a sense of unease," concluding that these concerns, alone, should not deter use of nuclear hearts.

However, the panel balked at some of the health hazards posed by the emission of radiation in the normal, day-to-day operation of the nuclear heart. These hazards, including cancer and genetic damage, would fall on the recipient himself, his wife and children, his close associates, and members of the general public with whom he came into contact. The panel concluded that the risks to a recipient's spouse and children are "apparently minor, but not trivial," while the risks to members of the public are "smaller, but still significant." It estimated that a full-scale artificial heart program using nuclear fuel would cause one extra case of cancer for every 7,200 spontaneous cases.

The panel argued that it is not "moral" to subject the public to such radiation risks, however small, when the battery system is available as an alternative.

A dissenting opinion was entered by Clark C. Havighurst, professor of law at Duke, who argued that it would be "anything but moral" to impose large costs on patients (by requiring them to use the technically less satisfactory electrical devices) simply to protect society as a whole against "very small risks." Havighurst suggested that the radiation hazard could be dealt with by such steps as regulatory curbs on the activities of bearers of the nuclear device.

Robert Ringler, deputy director of the Heart Institute, told SGR his agency will explore the issues raised "in greater depth — with individuals who are expert . . . The Green group acknowledged that they aren't radiation experts."

Young Switches from OMB to HEW

John D. Young, a key figure in scientific and technical affairs at the Office of Management and Budget and its predecessor, the Bureau of the Budget, over the past six years, is moving over to the Department of Health, Education, and Welfare, where he will be comptroller with the rank of assistant secretary. Young, who came to BoB from NASA, held the OMB title of deputy associate director for energy and science. Perhaps more so than many of his OMB colleagues, Young was noted for his ingrained skepticism toward appeals that the value of scientific research should be accepted on faith. At HEW he will be working closely with Secretary Caspar Weinberger, who has made no secret of his doubts concerning the value of much of HEW's research expenditures.

Academy Warns Soviets that Cooperation May End

The National Academy of Sciences, in a move which runs counter to Nixon Administration foreign policy, has warned Soviet officials that further harassment of outspoken physicist Andrei Sakharov will jeopardize American scientific cooperation with the Soviet Union.

The Academy, a private organization which performs quasi-government functions, serves as the official US representative in numerous bilateral and international scientific pacts.

In two cables sent to Mstislav V. Keldysh, president of the Soviet Academy of Sciences, NAS President Philip Handler expressed concern over political reprisals against Sakharov, a leading figure among Russian political and intellectual dissidents, who was elected a foreign associate of the NAS. "Harassment or detention of Sakharov will have severe effects on the relationships between the scientific communities of the US and USSR and could vitiate our recent efforts toward increasing scientific interchange and cooperation," Handler wrote in a cable whose wording was approved by the executive committee of the NAS Council.

Handler did not quite say that the NAS would refuse to cooperate as an institution, but he said that, if Sakharov were harassed, it would be "extremely difficult to imagine successful fulfillment of American pledges of binational scientific cooperation, the implementation of which is entirely dependent upon the voluntary effort and goodwill of our individual scientists and scientific institutions."

This implied threat appeared to conflict with Administration efforts to foster better relations with the Soviet Union. Secretary of State-designate Henry Kissinger, at his confirmation hearing in the Senate, shortly before the Academy released its cables, said he sympathized with Sakharov's situation. But Kissinger argued that concern over Soviet domestic policies should not be allowed to undermine the move toward detente. Similarly, HEW Secretary Caspar W. Weinberger, just back from a goodwill tour of health facilities in the Soviet Union, rebuked the NAS for "firing brickbats through the daily press." He said Soviet-American scientific cooperation was of "enormous value to mankind in general" and should transcend internal Soviet affairs.

The NAS appears to have been responding, in part, to requests from leading scientists for a public condemnation of Soviet harassment of Sakharov and other political dissidents. The Academy has gradually raised its voice as Soviet political repression has intensified. Last fall, NAS leaders complained privately to Keldysh while the Soviet Academician was on a visit to this country. In May, the Academy endorsed a statement to the International Council of Scientific Unions protesting curbs on the migration of scientists. Though the statement, which was endorsed by many other national academies as well, did not mention the Soviets, it was aimed in large part at Soviet refusal to grant exit visas to Jewish and dissident scientists. Finally, on September 9, after Sakharov had been subjected to intense vilification in the Soviet press because of his pleas that Soviet society be democratized, the NAS decided on a pointed, public statement. The cables were not cleared with government officials, according to Academy spokesmen.

The chief drafters of one of the Academy cables were Harrison Brown, of Caltech, the Academy's foreign secretary, and Harvard chemist Paul Doty. The chief drafter of the second, and longer cable, was Handler himself. Both cables were modified by many hands.

Doty, who is generally described as a crony of Kissinger's, assured SGR that Kissinger played no role in instigating or approving the Academy action. Doty said he has little contact with Kissinger these days and made no effort to get Kissinger's reaction to the cables. He also said he had asked the American Psychiatric Association to take a public stand against Soviet represssion. The APA was preparing to do just that as this issue went to press.

Fish Protein Program Draws Poor Marks in GAO Report to Congress

The General Accounting Office has recommended an end to the government's decade-long program to develop production methods for fish protein concentrate (FPC), which was once enthusiastically touted as a cheap solution to the worldwide protein shortage. In a limited circulation report to the House Merchant Marine and Fisheries Committee, the GAO concluded that an experimental plant at Aberdeen, Washington, has been useful for developing production processes for FPC "but did not demonstrate the economic feasibility to produce it commercially." The GAO also reported that the domestic market for the product is limited and that the US fishing industry "will not be enhanced" by an FPC industry.

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off basic research over the 1968-1972 period. "High risk-high payoff" research was defined as "projects which may have a low probability of producing results and yet promise results, if achieved, of such significance that the projects are deemed worth the risk." The current search for gravitational waves was cited as an example. The decline in risky research was attributed by the 12 panelists to overall economic factors, lack of understanding of the process of discovery, and general disaffection with technology.

Institutional Capabilities

The report documents a steady erosion in research equipment and laboratory facilities which it describes as the "basic tools of science." Expenditures for laboratory equipment under research grants from NSF and part of NIH declined between 1966 and 1971 even though overall grant funds increased. As a fraction of total grant funds, equipment expenditures fell from 12 per cent to 6 per cent during the period.

Similarly, federal funds to universities and colleges for R&D plant and major equipment declined 75 per cent between 1965 and 1971. Moreover, many fields of science were unable to obtain the major facilities (costing $5 million or more to build) deemed necessary "to achieve significant advances." As the report expressed it, "A radio astronomy facility (known as the VLA) authorized and funded in FY 1973 was the first new major research facility started since 1968, although some 30 facilities, in various areas of science, were proposed in recent years and evaluated as technically desirable and feasible."

Industrial Capabilities

A possible "declining rate of technological innovation" was found in the fact that large industrial companies (5,000 or more employees) employed 85 per cent of all industrial scientists and engineers in 1971, up from 70 per cent in 1958, while small companies (fewer than 1,000 employees) accounted for a declining proportion — 20 per cent in 1958 down to 6 per cent in 1971. The report cites many reasons for interpreting these data cautiously, but it concludes that "the rapid apparent decline of R&D in small firms may be a danger signal which calls for further investigation to determine its true significance. There is ample historical evidence to suggest that small firms have produced more than a proportionate share of major innovations. . ."

The report also found that the "R&D intensiveness" of US industry, as measured by the ratios of R&D expenditures to net sales and R&D scientists and engineers to total employment, increased from 1960 to 1964 but declined thereafter to a level in 1970 which was lower than in 1960. The largest declines occurred in the most R&D intensive industries. This was due almost entirely to reductions in federal funding of defense and space projects in these industries.

* * *

The most disappointing aspect of the report is its failure to present an overall judgment of the meaning of the data it presents. Is the US leadership position seriously jeopardized? Does it matter if the US fails to maintain a commanding lead in most areas of science? The questions are neither posed nor answered.

Another weakness in the report, acknowledged by the board, is its heavy reliance on data describing the resources put into R&D and its failure to come up with adequate measures of scientific output and the impact of science on national goals. But the report is intended as an initial, experimental effort which will be refined and updated annually. Development of a useful system of indicators "will be a difficult and long task," the board acknowledges.—PMB

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